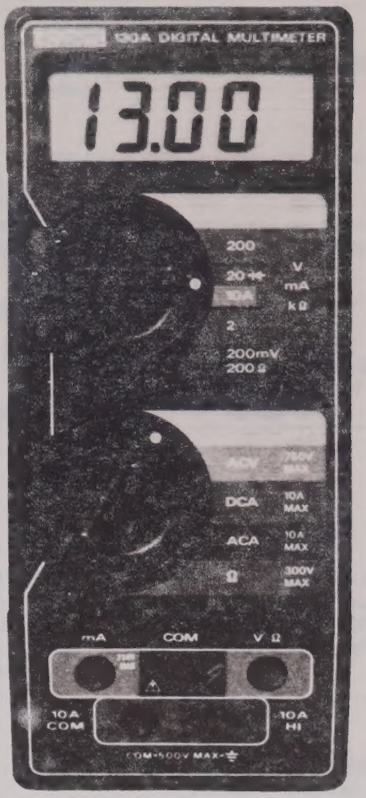
KEITHLEY 130A

DMM

KEITHLEY

Model 130A
Digital Multimeter
Instruction Manual



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KEITHLEY

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1 MODEL _____ SERIAL NUMBER _____

2 _____
YOUR NAME JOB TITLE

_____
COMPANY DIV/DEPT BLDG MS

_____
STREET ADDRESS

_____
CITY STATE/PROVINCE ZIP COUNTRY

3 Condition of unit upon receipt: ☐Satisfactory ☐Unsatisfactory (Why?) _____

_____ Phone _____

4 Check the category which best describes the business of your firm.

☐ Aerospace/Defense
☐ Aviation
☐ Communications
☐ Component/Semiconductor
☐ Computer/Office Equip.
☐ Electronic
☐ Government (Federal)
☐ Government (Local)
☐ HVAC
☐ Measurement/Test Equip.
☐ Medical Equip.
☐ University/Education
☐ Utility
☐ Other _____

5 Check the category which best describes your job.

☐ Education
☐ Test Group (QC, QA, Instrument Pool)
☐ Installation, Service
☐ Research
☐ Production
☐ Hobbyist
☐ Design or Development
☐ Repair, Maintenance
☐ Other _____

6 For what purpose do you use this instrument? _____

_____

7 On what scales/functions do you use this meter? _____

_____

8 Do you have any design suggestions concerning this unit? _____

_____

9 I purchased this unit:
☐ From a Keithley Sales Representative ☐ Direct from Keithley
☐ From a Keithley Distributor

10 Send me information on: _____

_____

Industrial

SPECIFICATIONS

DC VOLTS

RANGE	RESOLUTION	ACCURACY (2 YEARS) ±(%rdg + counts) 18°-28°C
200mV	100 μV	
2 V	1mV	
20 V	10mV	±(0.25% + 1)
200 V	100mV	
1000 V	1 V	

MAXIMUM ALLOWABLE INPUT: 1000V DC or peak AC non-switched, 750V peak switched.
INPUT RESISTANCE: 10MΩ.
NORMAL MODE REJECTION RATIO: Greater than 46dB at 50Hz, 60Hz.
COMMON MODE REJECTION RATIO: Greater than 100dB at DC, 50Hz and 60Hz (1kΩ unbalance).

AC VOLTS

RANGE	RESOLUTION	ACCURACY (2 YEARS)* ±(%rdg + counts) 18°-28°C	FREQUENCY RANGE
200mV	100 μV		
2 V	1mV		
20 V	10mV	±(1% + 3)	45Hz-500Hz
200 V	100mV		
750 V	1 V		

MAXIMUM ALLOWABLE INPUT: 1000V peak non-switched, 750V peak switched; continuous except 200mV range: 15s max above 300V.
INPUT IMPEDANCE: 10MΩ shunted by less than 100pF.
RESPONSE: Average responding, calibrated in rms of a sine wave.
***Above 10 counts.**

OHMS

RANGE	RESOLUTION	ACCURACY (2 YEARS) ±(%rdg + counts) 18°-28°C	FULL SCALE VOLTAGE
200 Ω	100mΩ	±(0.5% + 4)	< 0.5V
2 kΩ	1 Ω	±(0.2% + 1)	< 0.5V
20 kΩ	10 Ω	±(0.2% + 1)	> 0.7V
200 kΩ	100 Ω	±(0.2% + 1)	> 0.7V
20MΩ	10 kΩ	±(2 % + 1)	> 0.7V

MAXIMUM OPEN CIRCUIT VOLTAGE: 1.5V.
MAXIMUM ALLOWABLE INPUT: 300V DC or rms.

DC AMPS

RANGE	RESOLUTION	ACCURACY (2 YEARS) ±(%rdg + counts) 18°-28°C	MAXIMUM FULL SCALE VOLTAGE BURDEN
2mA	1 μA	±(0.75% + 1)	0.25V
20mA	10 μA	±(0.75% + 1)	0.25V
200mA	100 μA	±(0.75% + 1)	0.25V
2000mA	1mA	±(2% + 1)	0.7 V
10 A	10mA	±(2% + 1)	0.3 V

OVERLOAD PROTECTION: mA input: 2A fuse (250V), externally accessible; 10A input: 20A for 15s unfused.

AC AMPS

RANGE	RESOLUTION	ACCURACY (2 YEARS)* ±(%rdg + counts) 18°-28°C (45Hz-500Hz)	MAXIMUM FULL SCALE VOLTAGE BURDEN
2mA	1 μA	±(2% + 2)	0.25V
20mA	10 μA	±(2% + 2)	0.25V
200mA	100 μA	±(2% + 2)	0.25V
2000mA	1mA	±(3% + 5)	0.7 V
10 A	10mA	±(3% + 5)	0.3 V

OVERLOAD PROTECTION: mA input: 2A fuse (250V), externally accessible; 10A input 20A for 15s unfused.
***Above 10 counts.**

GENERAL

DISPLAY: 3½ digit LCD, 0.6" height, with polarity and range indication.
OVERRANGE INDICATION: 3 least significant digits blanked.
MAXIMUM COMMON MODE VOLTAGE: 500V peak.
OPERATING ENVIRONMENT: 0° to 50°C; less than 80% relative humidity up to 35°C, linearly derate 3% RH/°C from 35°C to 50°C.
STORAGE ENVIRONMENT: -35°C to 60°C.
TEMPERATURE COEFFICIENT: (0° to 18°C and 28° to 50°C): Less than 0.1 × applicable accuracy specification per °C.
POWER: 9V alkaline or carbon-zinc battery (NEDA 1604).
BATTERY LIFE: 100 hours typical with carbon-zinc cells, 200 hours with alkaline cells.
BATTERY INDICATOR: Diplay indicates BAT when less than 10% of life remains.
DIMENSIONS, WEIGHT: 178mm long × 78mm wide × 42mm thick (7.0" × 3.1" × 1.6"). Net weigth 283gm (10 oz.).
ACCESSORIES SUPPLIED: Battery, test leads and operating instructions.

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GENERAL INFORMATION

The Model 130A Digital Multimeter is supplied ready for use with a battery. Descriptions of other available accessories, and other general information concerning the instrument can be found below.

MANUAL ADDENDA

Information contained in this manual is believed to be accurate at the time of printing. Any improvements or changes to this manual will be documented in an addendum which will be included with the instrument.

OPTIONAL ACCESSORIES

Model 1301 Temperature Probe is a rugged low cost temperature probe designed to allow precision temperature measurement from -55°C to 150°C.

Model 1304 Soft Carrying Case and Stand

Model 1306 Deluxe Case is a rugged DMM carrying case that is large enough to accomodate the Model 130A plus various other DMM articles such as a spare battery, test leads, etc.

Model 1309 Spare Parts Kit is a collection of specially selected parts to maintain up to ten Model 130A DMMs for one year.

Model 1600A High Voltage Probe extends the DMM to 40kV. It has a 1000:1 division ratio, which means that 1V on the DMM corresponds to 1kV.

Model 1651 50-Ampere Shunt allows current measurements to be made up to 50-amperes. It is a 0.001Ω ±1% 4-terminal shunt. When the DMM is set to the 2V range, a 50-ampere current will correspond to 50mV (.0500V).

Model 1681 Clip-On Test Lead Set contains two leads, 1.2m (48 inches) long, terminated with banana plug and spring action clip-on probe.

Model 1682A RF Probe allows voltage measurements from 100kHz to 250MHz.

Model 1683 Universal Test Lead Kit consists of two test leads, 1.2m (48 inches) long with 12 screw-in tips, two banana plugs, two spade lugs, two alligator clips with boots, two needle tips with chucks and four heavy-duty tip plugs.

Model 1685 Clamp-On AC Current Probe measures AC current by clamping onto a single conductor. Interruption of the current path is unnecessary. The Model 1685 detects current by sensing magnetic field produced by current.

Model 1691 General Purpose Test Lead Set consists of two .91m (36 inches) test leads with probe tips terminated in banana plugs.

PREPARATION FOR USE

Carefully unpack the Model 130A from its shipping carton and inspect for any obvious signs of physical damage. Report any damage to the shipping agent at once. The following items are included with every Model 130A shipment.

1. Model 130A DMM
2. Model 130A Instruction Manual
3. 9V Battery NEDA 1604
4. Test Leads
5. Accessories as ordered.

BATTERY INSTALLATION/REPLACEMENT

The battery is accessible from the bottom of the instrument. Note the precautions on the case before installing or replacing the battery.

WARNING

Turn the Model 130A off and disconnect test leads before replacing the battery. Put the cover back into place on the compartment before resuming use of the instrument.

A 9V battery is supplied with the instrument but not installed. To install or replace the battery, remove the cover from the battery compartment by sliding it off in the direction of the arrow located on the battery cover. The battery connector snaps on and off the terminal of the battery. Improper installation of the battery will cause the connecting wires to be severed by excess strain. Proper installation requires that the battery be positioned in such a manner (see drawing) that the leads protruding from the boot of the battery connector face toward the outside of the battery compartment. If the instrument is going to be stored for a long period of time or in a high temperature environment, remove the battery to prevent leakage damage.

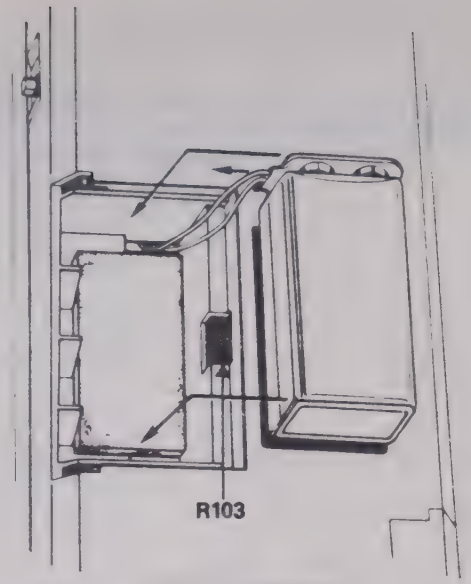


Figure 1. Battery Installation

SAFETY SYMBOLS AND TERMS

The symbol ⚠ on the instrument denotes that the user should refer to the operating instructions.

The symbol ⚡ on the instrument denotes that up to 1000V may be present on the terminal(s).

The **WARNING** used in this manual explains dangers that could result in personal injury or death.

The **CAUTION** used in this manual explains hazards that could damage the instrument.

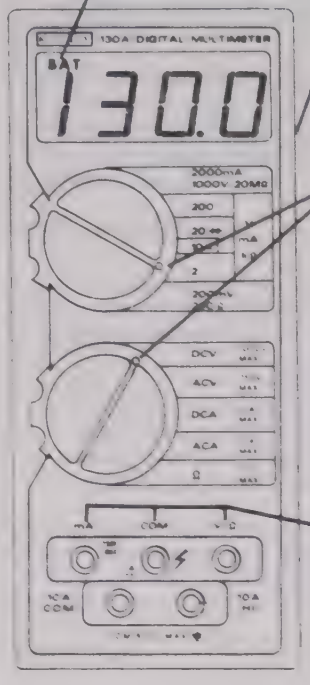
SAFETY PRECAUTIONS

The following safety precautions should be observed before operating the Model 130A DMM.

1. This instrument is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read over the manual carefully before operating this instrument.
2. Exercise extreme caution when a shock hazard is present at the instrument's input. The American National Standards Institute (ANSI) states that a shock hazard exists when voltage levels greater than 30V rms or 42.4V peak are present. A good safety practice is to expect that a hazardous voltage is present in any unknown circuit before measuring.
3. Inspect the test leads for possible wear, cracks or breaks before each use. If any defects are found, replace with test leads that have the same measure of safety as those supplied with the instrument.
4. For optimum safety do not touch the test leads or the instrument while power is applied to the circuit under test. Turn the power off and discharge all capacitors, before connecting or disconnecting the instrument.
5. Do not touch any objects which could provide a current path to the common side of the circuit under test or power line (earth) ground. Always make measurements with dry hands while standing on a dry, insulated surface, capable of withstanding the voltage being measured.
6. Exercise extreme safety when testing high energy power circuits (AC line of mains, etc.). Refer to the operation section.
7. Do not exceed the instrument's maximum allowable input as defined in the specifications and operation section.

OPERATION

The following paragraphs contain information concerning basic operation of the Model 130A. It is recommended that this information be reviewed before attempting to operate the Model 130A.



Low Battery Indicator

Minus sign indicates negative values. Plus sign implied. An over range condition is indicated by a "1" followed by a blank display.

SET POWER ON (slide switch located on side of instrument).

SELECT FUNCTION AND RANGE

DCV—200mV, 2V, 20V, 200V or 1000V

ACV—200mV, 2V, 20V, 200V, or 1000V

NOTE: 750VAC is maximum allowable AC input.

DCA—2mA, 20mA, 200mA, 2000mA or 10A

ACA—2mA, 20mA, 200mA, 2000mA or 10A

Ω—200Ω, 2kΩ, 20kΩ, 200kΩ or 20MΩ

INPUTS—Selects appropriate pair of input jacks.

COM, V-Ω—for all voltage and resistance measurements.

COM, mA—for current measurements up to 2000mA.

10A, COM, 10A, HI—for current measurements up to 10A.

Figure 2. Front Panel Controls

WARNING

Do not apply more than 500V peak above earth ground to the COM input jack.

CAUTION

Do not under any circumstance, use the 10A COM or 10A HI input jacks with the COM input jack for making measurements. This is a short and will damage the instrument.

SAFETY PRECAUTIONS FOR HIGH ENERGY CIRCUITS

To optimize safety when measuring voltage in high energy distribution circuits, read and use the directions in the following warning.

WARNING

Dangerous arcs of an explosive nature in a high energy circuit can cause severe personal injury or death. If the meter is connected to a high energy circuit, when set to a current range, low resistance range or any other low impedance range, the circuit is virtually shorted. Dangerous arcing can result even when the meter is set to a voltage range if the minimum safety spacing is reduced.

When making measurements in high energy circuits use test leads that meet the following requirements:

1. Test leads should be fully insulated.
2. Only use test leads than can be connected to the circuit (e.g. alligator or spade plugs) for a hands-off measurement.
3. Use test leads that do not reduce the arc protection by decreasing the voltage spacing.

Use the following sequence when testing power circuits:

1. De-energize the circuit using the regular installed connect-disconnect device such as the circuit breaker, main switch, etc.
2. Attach the test leads to the circuit under test. Use appropriate safety rated leads for this application.
3. Set the DMM to the proper function and range.
4. Energize the circuit using the installed connect-disconnect device and make measurements without disconnecting the DMM.
5. De-energize the circuit using the installed connect-disconnect device.
6. Disconnct the test leads from the circuit under test.

SERVICING INFORMATION

This section contains servicing information for the Model 130A.

WARNING

All service information is intended for qualified electronic maintenance personnel only.

FUSE CHECK

With the instrument set to the 2kΩ range, connect a jumper from the V-Ω jack to the mA jack. The display should read approximately .100. An overrange display would typically indicate a blown fuse. A display reading other than approximately .100 could indicate a defective current input circuit (see schematic).

FUSE REPLACEMENT

A 2-amp fuse protects the 2mA through 2000mA current ranges. To gain access to the fuse, remove the fuse compartment cover in the same manner as removing the battery compartment cover.

WARNING

Turn off the Model 130A and disconnect the test leads before replacing the fuse. Reinstall fuse compartment cover before attempting to operate the instrument.

Remove the fuse by pulling outward on the plastic tab that encircles the fuse body. Install the plastic tab on the new fuse and snap the fuse back into the fuse holder. Do not replace the fuse with a higher rated value or instrument damage that is not covered by the warranty may occur.

DIODE TEST

The 20kΩ range can be used for testing of semiconductor junctions. A junction is probably good if the Model 130A indicates an overrange reading when the semiconductor is reversed biased, and an on-range reading, when the semiconductor is forward biased. (The V-Ω jack is positive).

DISASSEMBLY INSTRUCTIONS

Place the unit face down on a bench or other similar surface and remove the battery compartment cover. Disconnect and remove the battery. Remove the two #4-40 X 7/8 retaining screws.

Grasp the bottom cover at the input jack end and with a lifting and forward pushing motion (see drawing), carefully remove the bottom cover. While removing the cover, feed the battery connector through the access hole in the bottom of the battery compartment.

The component side of the PC board is now exposed and the battery can be reconnected for troubleshooting. To read the display, some light downward pressure at the top of the circuit board may be required in order to make contact through the elastomer contact strip between the circuit board and the LCD.

The PC board and LCD assembly are not secured once the case retaining screws are removed. Be careful not to allow the PC board and LCD assembly to fall out or shift out of position during calibration.

To remove the PC board from the top cover, grasp the function switch assembly and lift until the input jacks become disengaged from the cover. The PC board can now be removed using a slight clockwise motion to free the two switch knobs from their normal positions in the case.

The LCD assembly will remain in the top cover when the PC board is removed. Again, be careful not to allow the LCD assembly to fall out accidentally.

The two switch knobs and bushings can be removed from the PC board assembly by simply pulling them off the switch shafts.

The LCD assembly, along with the zebra strip connector, lifts out of the case.

To reassemble the Model 130A, remove the cover on the fuse compartment (to position fuse pulling tab) and reverse the above procedures.

Be sure to replace the on-off switch cover. Common-mode voltage will be present on the switch, creating a possible hazard if the cover is not replaced.

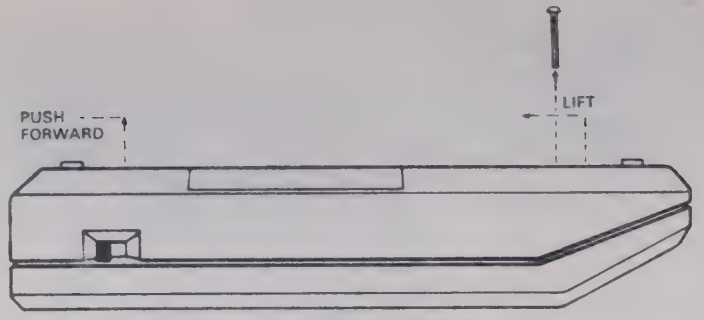


Figure 3. Rear Panel Removal

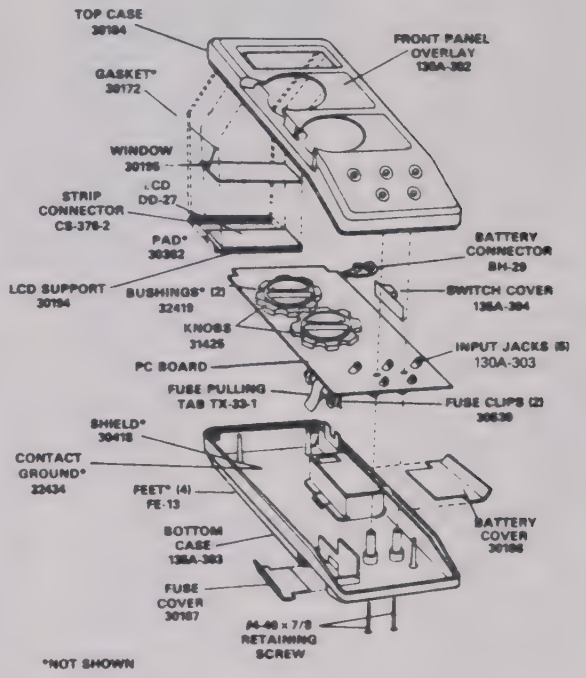


Figure 4. Model 130A Exploded View

CALIBRATION

Calibration should be performed every two years or whenever the instrument is known to be out of specification. Calibration should be done at an ambient temperature of 23° ±3°C (77° ±5°F), with a relative humidity of less than 80%.

Equipment Needed: +190mV DC voltage source with .05% accuracy or better.

Model 130A Settings: DCV function, 200mV range, V-Ω and COM input jacks.

CALIBRATION PROCEDURE

Remove the battery cover to gain access to the calibration pot R103 (see Figure 1). Apply the +190mV to the Model 130A input and adjust R103 for a display reading of 190.0 ±1 digit. This is the only adjustment needed to calibrate the instrument. Calibration should be performed every two years.

Model 130A Parts List

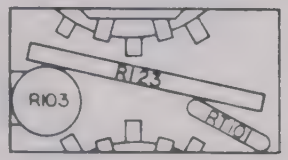
Circuit Desig.	Description	Sch Loc	Keithley Part No.
BT101	Battery, 9V, NEDA 1604	C4	BA-14
C101	Capacitor, 110pF, 500V, Mica	H3	C-320-110P
C102	Capacitor, .047μF, 100V, Polyester	F3	C-305-.047
C103	Capacitor, .047μF, 100V, Polyester	E4	C-305-.047
C104	Capacitor, .1μF, 100V, Polyester	G3	C-305-.1
C105	Capacitor, .1μF, 160V, Polypropylene	G3	C-306-.1
C106	Capacitor, 1.5μF, 20V, Tantalum	D4	C-314-1.5
C107	Capacitor, 4.7μF, 20V, Tantalum	D2	C-314-4.7
C108	Capacitor, 1.5μF, 20V, Tantalum	D4	C-314-1.5
C109	Capacitor, .02μF, 1000V, Ceramic Disc	C2	C-316-.02
C110	Capacitor, .1μF, 50V, Ceramic	C2	C-238-.1
C111	Capacitor, .1μF, 50V, Ceramic	D2	C-238-.1
C112	Capacitor, 1μF, 20V, Tantalum	D2	C-325-1
C113	Capacitor, 4.7μF, 20V, Tantalum	F1	C-314-4.7
CR101	Rectifier, 1A, 800V	C4	RF-38
CR102	Rectifier, 75mA, 75V	C6	RF-28
CR103	Rectifier, 75mA, 75V	C2	RF-28
CR104	Rectifier, 75mA, 75V	C2	RF-28
CR105	Rectifier, 75mA, 75V	D2	RF-28
CR106	Rectifier, 75mA, 75V	D2	RF-28
CR107	Rectifier, 3A, 50V	A4	RF-34
CR108	Rectifier, 3A, 50V	B4	RF-34
CR109	Rectifier, 75mA, 75V	B3	RF-28
DS101	Liquid Crystal Display	G5	DD 27
	Connector, Strip	-	CS-376-2
F101	Fuse, 2A, 250V, 3AB, Ceramic Body	A4	FU-62
J1001	Jack, Input	A1	130A-303
J1002	Jack, Input	A4	130A-303
J1003	Jack, Input	A4	130A-303
J1004	Jack, Input	B5	130A-303
J1005	Jack, Input	B5	130A-303
J1006	Connector Battery	C4	BH-29
Q101	Transistor, NPN, Switch, 2N3904	E5	TG-47
Q102	Transistor, NPN, Silicon, GES5818	E3	TG-138
R101	Thick Film Resistor Network	SEV	TF-97
R102	Thick Film Resistor Network	SEV	TF-119
R103	Pot, 500Ω	G2	RP-119-500
R104	Thick Film Resistor Network	B3,B4	TF-94
R105	Resistor, 1MΩ, 10%, 1W, Comp	E4	R-2-1M
R106	Resistor, .1Ω, .5%, 1W, WW	B4	R-279-.1
R107	NOT USED		

Model 130A Parts List (Cont.)

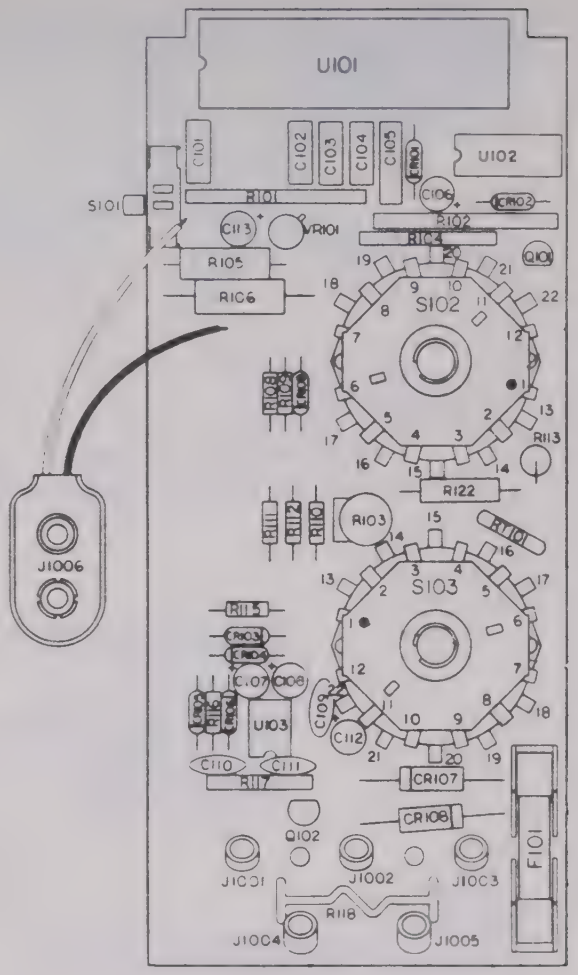
Circuit Desig.	Description	Sch Loc	Keithley Part No.
R108	Resistor, 100Ω, .1%, 1/10W, MtF	B3	R-283-100
R109	Resistor, 900Ω, .1%, 1/10W, MtF	B2	R-283-900
R110	Resistor, 9kΩ, .1%, 1/10W, MtF	B2	R-283-9k
R111	Resistor, 90kΩ, .1%, 1/10W, MtF	B2	R-283-90k
R112*	Resistor, 900kΩ, .1%, 1/10W, MtF	B2	R-283-900k
R113	Resistor, 100kΩ, 10%, 1W, Comp	C1	R-2-100k
R114	NOT USED		
R115	Resistor, 4.72kΩ, .1%, 1/10W, MtF	D3	R-283-4.71k
R116	Resistor, 10kΩ, .1%, 1/10W, MtF	D2	R-283-10k
R117	Thick Film Resistor Network	SEV	TF-96
R118	Resistor, 0.01Ω, 0.5%, 1W, WW	B5	R-280-.01
R119	NOT USED		
R120	NOT USED		
R121	NOT USED		
R122*	Resistor, 9MΩ, .08%, 2W	B1	R-281-9M
R123*	Thick Film Resistor Network	B1	TF-104
RT101	Thermistor, 8mA, 500V, PTC	E2	RT-7
S101	Switch, SPDT, ON-OFF	C4	SW-417
S102	Switch, Rotary, Range	SEV	SW-432
S103	Switch, Rotary, Function	E2,F2	SW-433
U101	3 1/2-Digit Single Chip A/D Converter	G4	32440
U102	CMOS Quad Exclusive OR Gate	F5,F6	30847
U103	Low-Power JFet-Input OP-Amp	C2	IC-227
VR101	Diode, Low Voltage Reference	G1	DZ-62
	Supplied Test Lead Set		CA-8

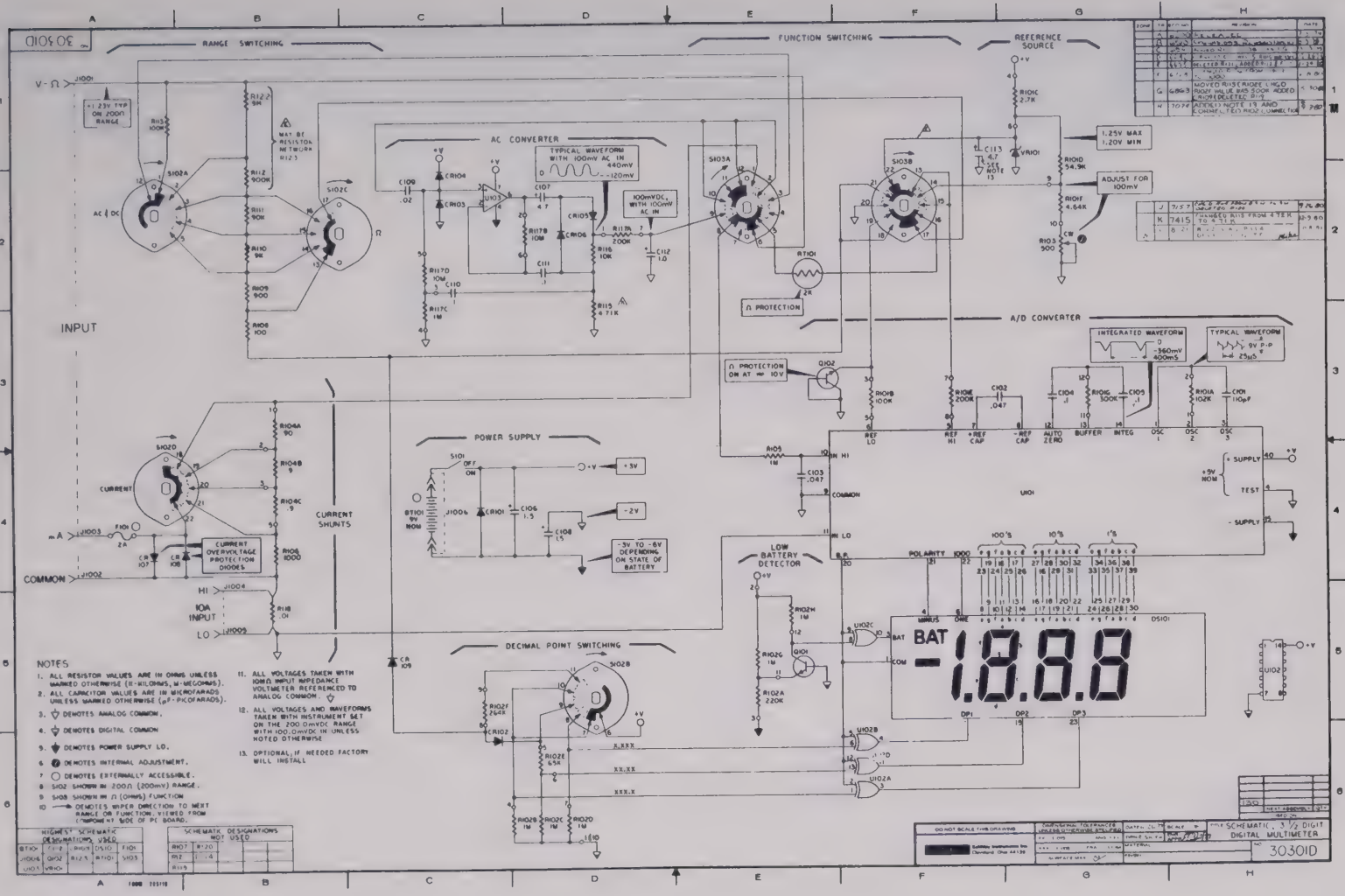
*R123 may be installed in your unit in place of R122 and R112 (see alternate configuration)

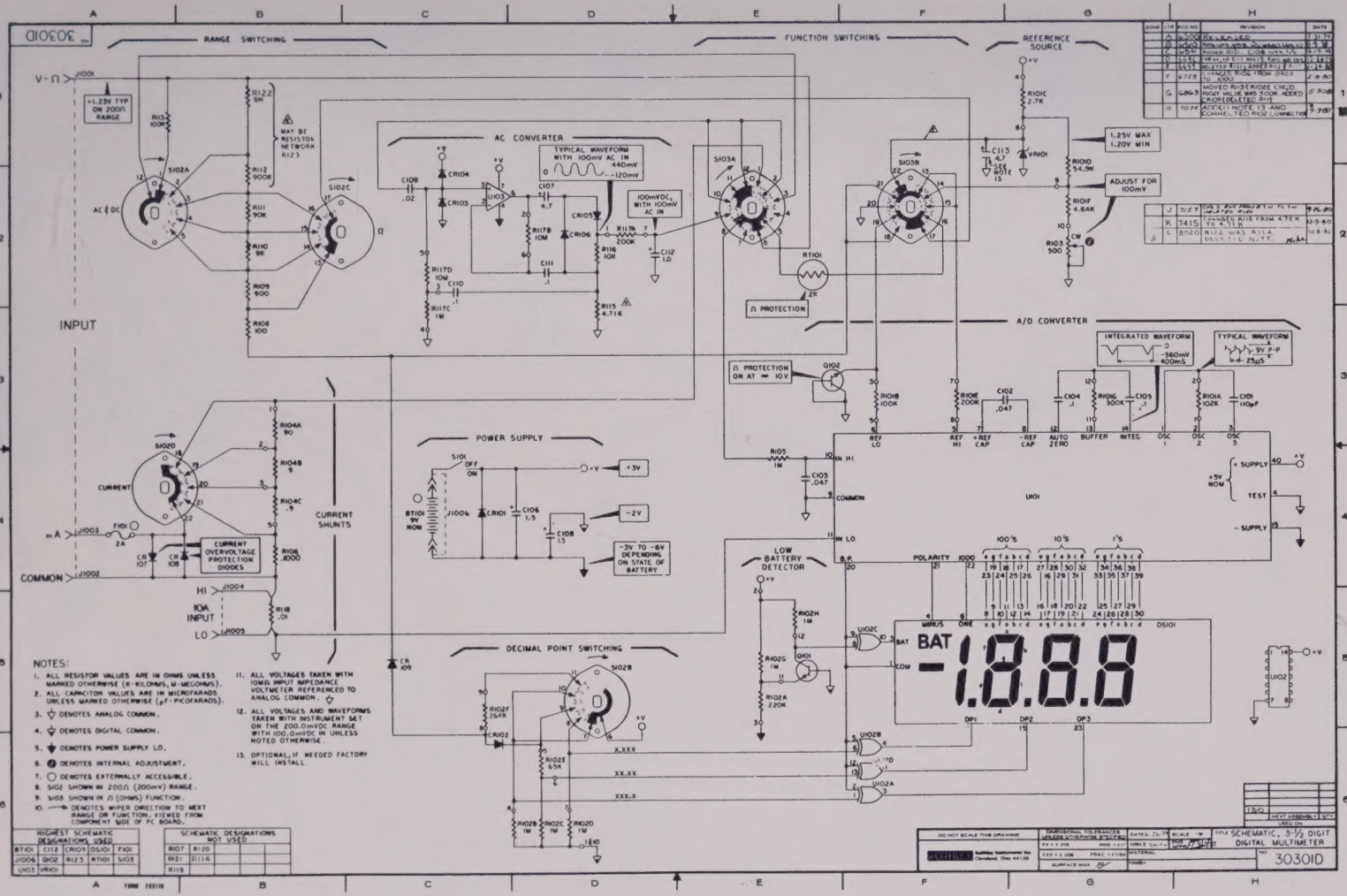
ALTERNATE CONFIGURATION

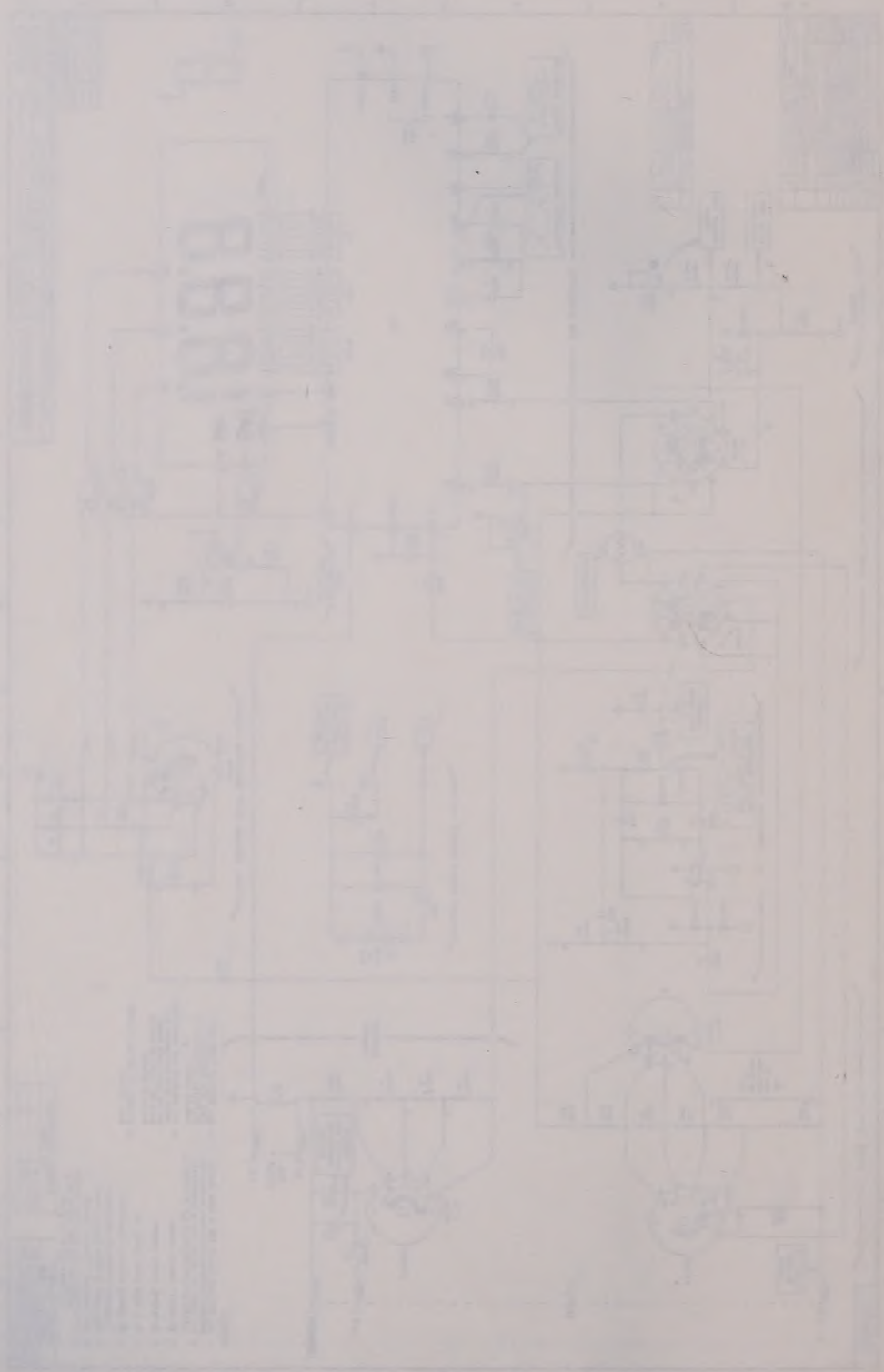


COMPONENT LAYOUT




RANGE SWITCHING
FUNCTION SWITCHING
REFERENCE SOURCE
AC CONVERTER
A/D CONVERTER
POWER SUPPLY
DECIMAL POINT SWITCHING
LOW BATTERY DETECTOR
INPUT
CURRENT SHUNTS
CURRENT OVERVOLTAGE PROTECTION DIODES
Ω PROTECTION
COMMON
HI
LO
10A INPUT
mA
V-Ω
AC ⇕ DC
1.25V MAX
1.20V MIN
ADJUST FOR 100mV
INTEGRATED WAVEFORM
TYPICAL WAVEFORM
POLARITY
BAT
-1.8.8.8
DS101
U101
U102
U103
U104
+SUPPLY
-SUPPLY
TEST
+9V NOM
NOTES
1. ALL RESISTOR VALUES ARE IN OHMS UNLESS MARKED OTHERWISE (K=KILOHMS, M=MEGOHMS).
2. ALL CAPACITOR VALUES ARE IN MICROFARADS UNLESS MARKED OTHERWISE (pF=PICOFARADS).
3. DENOTES ANALOG COMMON.
4. DENOTES DIGITAL COMMON
5. DENOTES POWER SUPPLY LO.
6. DENOTES INTERNAL ADJUSTMENT.
7. DENOTES EXTERNALLY ACCESSIBLE.
8. SW2 SHOWN IN 200Ω (200mV) RANGE.
9. SW3 SHOWN IN Ω (OHMS) FUNCTION
10. DENOTES WIPER DIRECTION TO NEXT RANGE OR FUNCTION, VIEWED FROM COMPONENT SIDE OF PC BOARD.
11. ALL VOLTAGES TAKEN WITH 10MΩ INPUT IMPEDANCE VOLTMETER REFERENCED TO ANALOG COMMON.
12. ALL VOLTAGES AND WAVEFORMS TAKEN WITH INSTRUMENT SET ON THE 200.0mVDC RANGE WITH 100.0mVDC IN UNLESS NOTED OTHERWISE
13. OPTIONAL, IF NEEDED FACTORY WILL INSTALL
DIGITAL MULTIMETER
30301D


RANGE SWITCHING
FUNCTION SWITCHING
REFERENCE SOURCE
AC CONVERTER
A/D CONVERTER
POWER SUPPLY
DECIMAL POINT SWITCHING
LOW BATTERY DETECTOR
Ω PROTECTION
INPUT
CURRENT SHUNTS
COMMON
HI
LO
10A INPUT
NOTES:
BAT
-1.8.8.8
DIGITAL MULTIMETER
30301D



Smead
No. Y129
HASTINGS, MN - LOS ANGELES
LOGAN OH - McGREGOR, TX U. S. A.